A PREDICTABLE COMPARISON OF IDEAL SKIN COVER FOR SOLE DEFECTS OF VARIOUS ETIOLOGY

A dissertation submitted

In partial fulfilment of the regulations

For the award of the degree

MASTER OF CHIRURGIAE

BRANCH-III

PLASTIC SURGERY

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MADURAI MEDICAL COLLEGE

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

CERTIFICATE

This is to certify that the dissertation entitled ***"A predictable comparison of ideal skin cover for sole defects of various etiology"*** is a bonafide work done by **Dr.G.ARUN**, in Madurai Medical College & Government Rajaji Hopital, Madurai in partial fulfilment of the University rules and regulations for award of **MASTER OF CHIRURGIAE in PLASTIC SURGERY** under my guidance and supervision during the academic year 2011 to 2014

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DECLARATION

I, **Dr.G.ARUN** solemnly declare that the dissertation titled ***"A predictable comparison of ideal skin cover for sole defects of various etiology"*** is a bonafide work done by me at Government Rajaji Hospital during 2011 – 2014 under the guidance and supervision of my unit chief Prof**.Dr.S.Gnanasekharan, M.S.,M.Ch.,** Professor & HOD, Department of Plastic & Reconstructive surgery, Madurai Medical College & Government Rajaji Hospital, Madurai.

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CONTENT

INTRODUCTION

On an average, a person takes about 10,000 steps a day. No tissue in the human body is like the sole which experiences such stress. Due to the specialized plantar tissue, our feet can withstand such a repetitive direct and shear stress forces. Defects in the sole can cripple a person as it can adversely affect the patient's mobility. Inability to salvage an injured foot can lead to major amputation and a lifetime dependence on the prosthesis.

Since man has taken upright position,foot gained more importance.It supports the entire body weight and aids in standing, walking, and running, jumping and climbing. The foot has lost its primitive function of grasping significant in our evolutionary ancestors namely, chimpanzees and gorillas(Fig 1).

The changes include both the skeleton framework and the surrounding skin. Skeleton changes include a reduction in the distal area of the phalanges & the enlargement of the proximal bones. The skin and soft tissue of the sole has acquired non-shearing and padding properties which strengthens the feet to support the entire body weight.

Reconstructing these sole defects are extremely challenging. Till date, there is no ideal replacement for the sole skin. Unless the sole is replaced by a sole skin there will be recurrent problems. The search for ideal replacement is ongoing. Based on the available flaps, the ideal reconstruction options for different types of defects, in different locations of the sole are explored in this dissertation. Based on the data a practical algorithmic approach to sole reconstruction has been elucidated.

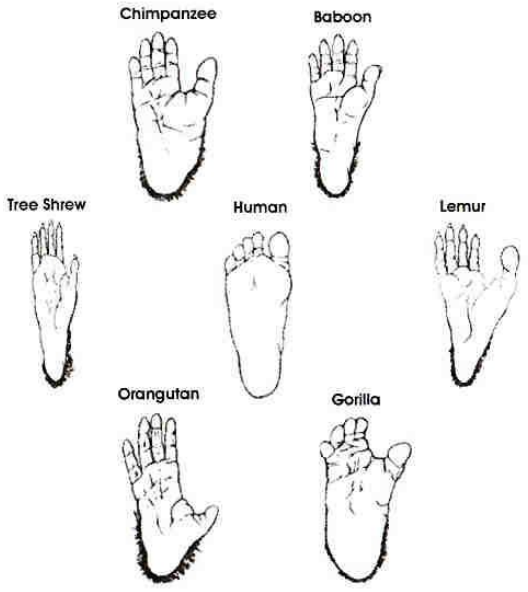


Fig. 1 Evolution of human foot

AIM OF THE STUDY

To find the ideal reconstruction for sole defects and formulate an algorithm for the management of sole defects.

Objectives:

1. To use different types of existing reconstruction techniques for sole defects of various etiology.
2. Enumerate the advantage and disadvantage of the identified reconstruction methods.
3. Find the ideal reconstruction for sole defects

REVIEW OF LITERATURE

Anatomy:

The part of foot that contacts the floor is known as the sole or plantar region. There is a marked variation in the thickness and texture of skin, subcutaneous tissue, and deep fascia in relationship to weight bearing. It is a specialized type skin which withstands the entire weight of the person.

Sole can be studied under

1. Skin
2. Subcutaneous tissue
3. Plantar Fascia
4. Muscles
5. Skeletal framework

1. Skin:

Sole skin is a glaborous type skin. The skin over the major weight-bearing areas of the sole the heel, lateral margin, and ball of the foot is thick. The epidermis is thin in the newborn but becomes thicker as progressive

weight bearing. Hair,pigmentation, sebaceous glands are absent whereas the eccrine glands are diffuse in the sole.

2. Subcutaneous tissue:

The subcutaneous tissue in the sole is more fibrous. Highly developed Fibrous septa skin ligaments divide this tissue into fat-filled areas, making it a shock-absorbing pad, especially over the heel. These skin ligaments also anchor the skin to the underlying plantar aponeurosis, improving the grip of the sole.

3. Plantar fascia:

The deep fascia of the sole is the plantar fascia. It is thick in the central part and weaker in the medial and lateral parts.It resembles the palmar aponeurosis of the palm of the hand but is tougher, denser, and elongated.The plantar aponeurosis arises posteriorly from the calcaneus and distally the aponeurosis divide into five bands that become continuous with the fibrous digital sheaths that enclose the flexor tendons that pass to the toes. Anteriorly, the aponeurosis is reinforced by transverse fibers forming the superficial transverse metatarsal ligament.

In the midfoot and forefoot, vertical intermuscular septa extend deeply from the margins of the plantar aponeurosis toward the 1st and 5th metatarsals, forming the three compartments of the sole.

3.1 Foot Compartments:

- The medial compartment of the sole is covered superficially by thinner medial plantar fascia. It contains the abductor hallucis, flexor hallucis brevis, the tendon of the flexor hallucis longus, and the medial plantar nerve and vessels.
- The central compartment of the sole is covered superficially by the dense plantar aponeurosis. It contains the flexor digitorum brevis, the tendons of the flexor hallucis longus and flexor digitorum longus plus the muscles associated with the latter, the quadrates plantae and lumbricals, and the adductor hallucis. The lateral plantar nerve and vessels are located here.
- The lateral compartment of the sole is covered superficially by the thinner lateral plantar fascia and contains the abductor and flexor digiti minimi brevis.

4. Muscles:

Muscles include both intrinsic and extrinsic. They are

4.1 Intrinsic muscles of foot

Intrinsic muscles of the foot are arranged into 4 layers

1st Layer – Abductor halluces, Flexor digitorum brevis, abductor digiti minimi

2nd Layer – Quadratus plantae, Lumbricals

3rd Layer – Flexor halluces brevis, Adductor halluces, Flexor digiti minimi brevis

4th layer – Interossei

4.2 Extrinsic muscles of foot

The muscles of the leg form tendons and pass in to the foot behind the medial and lateral malleolus.They are tibialis posterior, flexor digitorum longus, flexor halluces longus and the peroneus longus.

5. **Skeletal framework:**

The skeletal framework of foot includes the tarsal bones, metatarsal bone, and the phalanges. There are 7 tarsal bones, 5 metatarsal bones, and 14 phalanges.

- The hind foot consists of the talus and calcaneum
- The mid foot includes the navicular, cuboid and cuneiforms
- The hind foot includes the metatarsals and phalanges.

5.1 Arches of foot and the pressure points:

The arches of the foot (Fig.2) are formed by the tarsal bone, metatarsal bones and supported by ligaments and fascia, limited by the tubercle of os calsis proximally and by the metatarsal head in the distal foot. Alteration in the foot arches can lead to abnormal pressure points (Fig.3) and can lead to ulcerations in neuropathic foot. The arch can be classified as

a. **Longitudinal arch**

The medial longitudinal arch is at a higher level than the lateral longitudinal arch. That is why on the foot print the medial side is missing.The weight of the body would flatten the longitudinal arches

when the foot is on ground and when the foot is off the ground the arch springs back to normal position.

b. Transverse arch

There are series of transverse arches. They arenot true arches

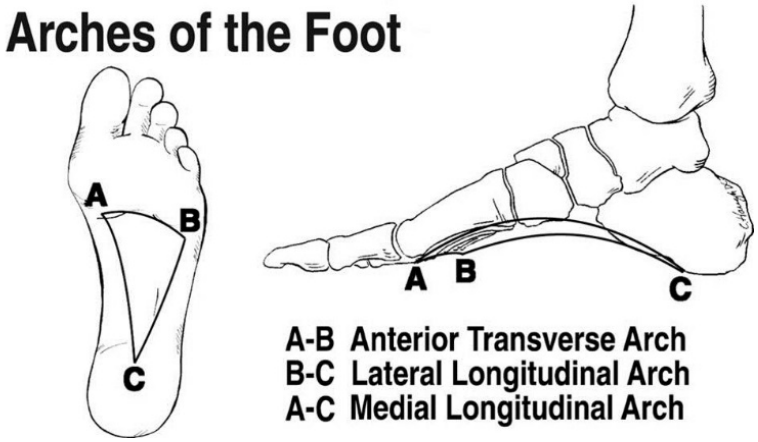


Fig. 2 Arches of foot

Fig. 3 Types of arches

Arteries of the Sole of the Foot:

The sole of the foot has a rich blood supply that is derived from the posterior tibial artery, which divides deep to the flexor retinaculum.Deep to the abductor halluces the posterior tibial artery divide into the terminal branches the medial and lateral plantar arteries, which accompany the similarly named nerves.

1. Medial Plantar Artery:

The medial plantar artery is the smaller terminal branch of the posterior tibial artery. It gives rise to a deep branch that supplies mainly muscles of the great toe. The larger superficial branch of the medial plantar artery supplies the skin on the medial side of the sole and has digital branches that accompany digital branches of the medial plantar nerve, the more lateral of which anastomose with medial plantar metatarsal arteries.

2. Lateral Plantar Artery:

The lateral plantar artery is much larger than the medial plantar artery. It runs laterally and anteriorly, at first deep to the adductor halluces and then between the flexor digitorum brevis and quadrates Plantae. The lateral plantar artery arches medially across the foot with the deep branch of the lateral

plantar nerve to form the deep plantar arch, which is completed by union with the deep plantar artery, a branch of the dorsal artery of the foot. As it crosses the foot, the deep plantar arch gives rise to four plantar metatarsal arteries; three perforating and many branches to the skin, fascia, and muscles in the sole.

Venous drainage:

There are both superficial and deep vein in the foot. The deep veins take the form of inter anastomosing paired veins accompanying all arteries internal to the deep fascia. The superficial veins are subcutaneous and unaccompanied by arteries. Unlike the veins in thigh and leg, the major venous drainage is through the superficial veins.

Nerves of sole of foot:

1. **Saphenous Nerve:**

It is the largest and longest cutaneous branch of femoral nerve. It supplies skin over the anteromedial aspect of leg and medial border of foot till the head of 1st metatarsal bone. It also supplies the articular branch to the ankle joint.

2. Medial plantar Nerve:

It is the larger terminal branch of posterior tibial nerve that traverses deep to the flexor retinaculum and enters the sole by passing deep to abductor halluces. After giving motor branches to flexor halluces brevis and 1st lumbrical the nerve terminates near the bases of metatarsals by dividing into three common digital nerve. These branches supply the skin of the medial three and a half digits. Compared to the other terminal branch of the tibial nerve, the medial plantar nerve supplies more skin area but fewer muscles. Its skin and muscle distribution is comparable to median nerve of palm.

3. Lateral Plantar Nerve:

It is the smaller and more posterior of the two terminal branches of the tibial nerve that courses deep to the abductor halluces; between the 1st and 2nd layers of plantar muscles. The lateral plantar nerve terminates as it reaches the lateral compartment, dividing into superficial and deep branches. The superficial branch divides in turn, into two plantar digital nerves that supply the skin of the plantar aspects of the lateral one and a half digits. The superficial and deep branches supply all muscles of the sole not supplied by the medial plantar nerve. Compared to the latter, the lateral plantar nerve supplies less skin

area but more individual muscles. Its distribution in the foot is comparable to that of the ulnar nerve in the hand.

4. Sural Nerve:

The sural nerve accompanies the short saphenous vein and enters the foot posterior to the lateral malleolus to supply the ankle joint and skin along the lateral margin of the foot

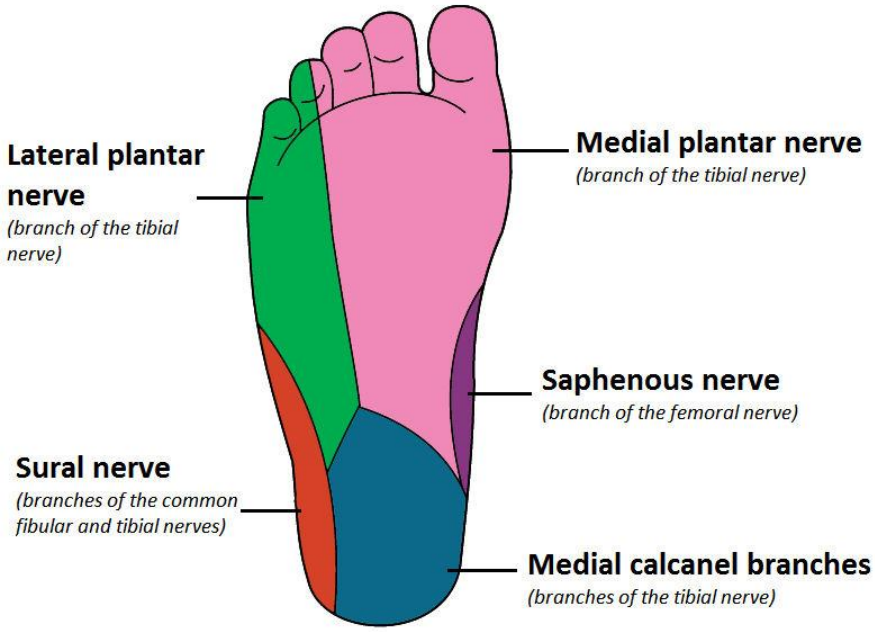


Fig.4 Nerve Supply

Variations in neurovascular structures:

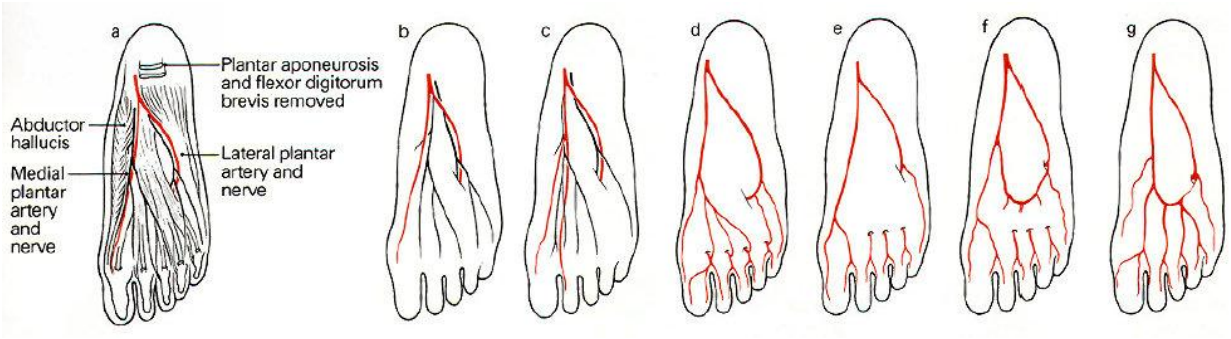


Fig.5 Variations in neurovascular supply

A – Normal, arteries lie lateral to nerves

B – Medial plantar artery lie medial to medial plantar nerve

C – Double medial plantar artery, lie one on either side of the nerve

D – No superficial plantar arch, the medial plantar artery supplies the toes via common digital artery

E – No Superficial arch, plantar metatarsal arteries supplies the toes

F – Superficial arch present but doesn't supply the toes

G – Superficial arch form the main supply of the sole

Etiology:

The weight-bearing portion of the foot is subject to more repetitive trauma than any other part of the body. The following can lead to defect in the sole,

1. **Traumatic:**

   Post traumatic sole defects are the most common cause for sole defects. This accounts for 50% of the defects, due to the rise in motor vehicular accidents and mostly involving young active people. Trauma also can act as precipitating factor on a preexisting situation like ischemic, neuropathic and deformed foot.Hidalgo and Shaw[1] divided foot traumas into 3 classes according to dimension and extension of the lesion, as follows,

   - Type I - Small soft tissue loss less than 3 cm^2
   - Type II - Large tissue loss greater than 3 cm^2 without bone involvement
   - Type III - Large tissue loss with bone involvement

2. **Infective:**

   Infective ulcers often are secondary to traumas, vascular deficiencies, or diabetes. All these pathologies leads to a low peripheral oxygenation

and promote anaerobes, gram-negative organisms, and saprophyte infections.

3. Tumour:

Foot tumours are rare. Amongst them Melanoma is the most common tumour and accounts for 5% of the foot defects.

4. Trophic ulcer:

Trophic ulcer results from Hansens disesase, diabetic neuropathy, spina bifida, spinal injuries, peripheral nerve injuries and other spinal conditions.

5. Diabetic foot ulcer:

Next to trauma diabetic foot ulcers are the most common reason for the sole defects. They can trophic, infective or combined ulcers.

6. Malformation:

Congenital diseases, such as the clubfoot or the spina bifida, are rare. They are associated with deformity of the skeletal and neurologic system of the foot. These deformities alter the biomechanics of the foot and can lead to ulcers in the weight bearing region of the foot.

Investigations:

1. Blood investigations:For evaluation of Blood sugar and renal parameters.
2. Radiological investigations:
    a. X-ray foot – To evaluate the underlying bony status, fractures and preexisting deformity.
    b. Leucocyte lymphoscintigraphy– Useful in patients to detect early osteomyelitis
    c. Baropodometric evaluation or gait analysis (Fig.6) - To identify eventual bone functional loss and to plan a repair of the arches.

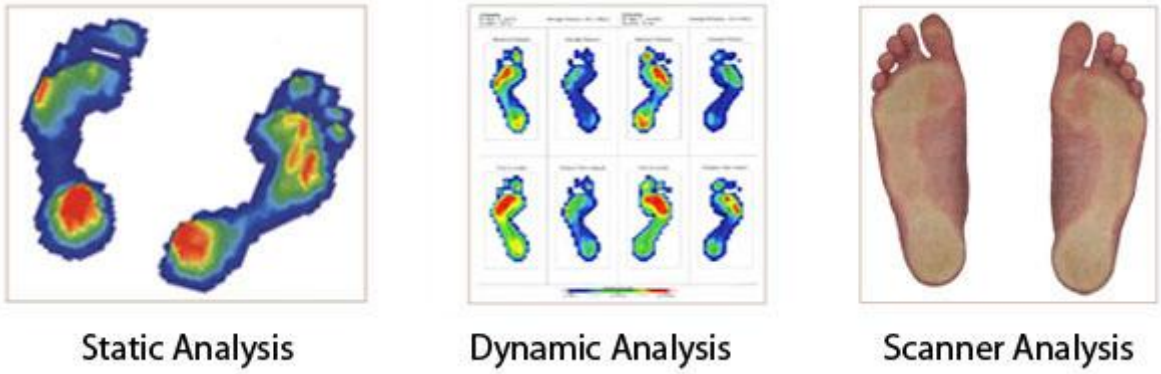


Fig.6 Baropodometric analysis

d. MRI - Indicated to study ligaments and joints. Also to evaluate the soft tissue damage.

3. Vascular Doppler - To evaluate the vascular status of the leg.

Reconstructive Options- By anatomic location

1. Plantar Hindfoot

2. Plantar midfoot

3. Plantar forefoot

1. Plantar Hindfoot:

Hindfoot soft tissue repair is of the greatest challenge to the reconstructive surgeon. The hindfoot is a very specialized location, with specific requirements for its repair. In addition to the thick, durable heel pad and the underlying calcaneus, the Achilles' tendon and its thin, pliable soft tissue envelope must be managed appropriately. Reconstruction should provide durable soft tissues for safe weight bearing while permitting near normal ankle motion. More than any other region in the foot, the surgeon must consider both form and function when managing wounds in this area

1. Medial Plantar artery flap
2. Reverse sural artery flap[6]
3. Intrinsic muscle flap [10-13]
    a. Abductor hallucisbrevis
    b. Flexor digitorum brevis

c. Abductor digiti minimi

4. Free flaps
5. Cross limb flap

1. Medial plantar artery flap:

It is a fasciocutaneous flap (Fig.7) raised from the instep area to cover the defects of heel. It is an axial pattern flap based on medial plantar artery; one of the terminal branches of posterior tibial artery. The artery arise between the abductor halluces brevis and Flexor digitorum brevis. The Flap can be islanded and the artery can be skeletonized till its entry into the sole i.e. the lateral border of abductor halluces brevis. This flap is quite useful for heel pad reconstruction, provided the instep is not a weight-bearing surface as can occur with Charcot midfoot collapse[2]. The donor site must be skin grafted; hence, when instep collapse is present, a relative contraindication to this procedure exists.

Advantage:

1. Replacement of sole tissue for sole
2. It is a sensate flap i.e. the sensation of the flap is preserved, which is very essential in foot reconstruction. It prevents further injury to the flap.

Disadvantage:

1. The donor site must be skin grafted.

Technique:

The flap is outlined over the medial instep of the foot centered on the medial plantar artery as isolated with the hand held Doppler. The distal extent of the flap is incised first, through the skin and plantar fascia. The medial plantar neurovascular bundle is readily found in the cleft between the abductor halluces and the flexor digitorum brevis muscles. The vessels are divided and elevated with the flap. An intraneural dissection of the medial plantar nerve is performed so that the cutaneous fascicles from the plantar nerve are preserved with the flap. The dissection plane is superficial to the muscles, just deep to the plantar fascia. The deep fascial septa in the clefts between the muscles must be divided. For most reconstructions, the dissection may stop where the vessels emerge from the lateral border of the abductor halluces muscle. The donor area is covered with a split skin graft.

Modification:

1. Further mobilization is possible by dividing abductor halluces brevis muscle and the laciniate ligament and tracing the medial plantar artery to its origin from the posterior tibial artery to cover defects of ankle region.
2. REVERSE FLOW Y-V PEDICLE EXTENSION OF THE FLAP[3]: By dividing the medial plantar artery close to its bifurcation from posterior tibial artery, a reverse flow to the artery can be established through the lateral plantar artery[4, 5;] which can be advantageous to cover defects in the forefoot region.
3. It is a difficult flap for beginners. For most of the defects in heel, the flap can be raised without islanding and inset can be given without tension. Though a dog-ear is inevitable when transposed, it settles down in time without needing for a second procedure.

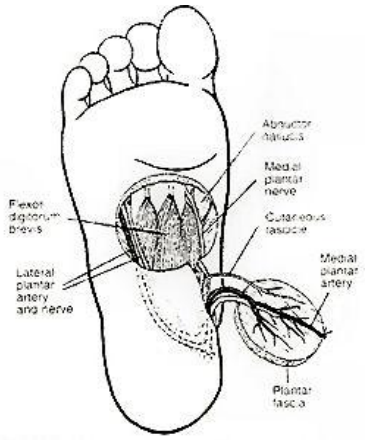


Fig.7 Medial plantar artery flap

2. Reverse sural artery flap:

The retrograde sural nerve flap[6] is a versatile neurofasciocutaneous flap that is useful for ankle and posterior heel defects. It is an axial pattern flap based on the reverse flow in the median sural artery surrounding the sural nerve from the communication with the peroneal artery perforator which is 5cm above the lateral malleolus.

The artery first courses above the fascia and then goes deep to the fascia at midcalf while the accompanying lesser saphenous vein remains above the fascia. The venous congestion often seen with this flap can be minimized if the pedicle is harvested with 3 cm of tissue on either side of the pedicle and with the overlying skin intact[7]. Problems with the venous drainage can be further helped by delaying the flap 2–3 weeks earlier and ligating the proximal lesser saphenous vein and sural artery[8,9]. The inset of the flap is critical to avoid kinking of the pedicle.

The conventional flap can be raised utilizing lower 2/3 of posterior calf skin,which will have an arc of rotation to cover posterior aspect of heel. To cover defects of the plantar aspects of heel a delay will be required prior to raising the flap. The flap pedicle is formed by elevating a medial and lateral

skin flap and then developing a 3–4 cm wide “strip” of subcutaneous fat and fascia that harbor the sural nerve and lesser saphenous vein.

Donor site will require a split skin graft to cover the defect. In a well vascularized extremity, the pedicle can be removed after 3–4 weeks to improve the contour of the leg.

Disadvantage:

1. Loss of sensibility along thelateral aspect of the foot
2. Skin grafted depression at the posterior calf donor site
3. Recurrent junctional ulcers
4. Flap wobbling
5. Hair growth in the flap.
6. Bulky – requires secondary reduction procedures.

3. Intrinsic muscle flap:

The abductor halluces, flexor digitorum brevis, and abductor digiti minimi muscles may be used individually or together to repair small wounds in the hind foot region[10-13]

a. Abductor halluces brevis flap: Can be used to cover heel, medial aspect of ankle joint and over medial malleoli.

The abductor halluces arises from the medial tubercle of the calcaneus and the surrounding fascia. The fleshy belly gives rise to a tendon at about the midfoot that inserts into the medial side of the proximal phalanx of the big. The neurovascular supply from the medial plantar nerve and vessels that arises proximally about two to three fingerbreadths behind the navicular tuberosity.

Technique:

The muscle is exposed by an incision that lies just above the medial border of the sole of the foot and curves from the heel to the ball of the big toe. The tendon is divided proximal to the metatarsophalangeal joint and dissected proximally. Because the neuromuscular bundle enters from the lateral side, the medial border of the muscle is first mobilized until the calcaneal origin is reached.

b. Flexor digitorum brevis:

Used exclusively to cover heel.The muscle arises from the medial tubercle of calcaneum and plantar aponeurosis. The muscle belly splits into four tendons, at the level of proximal phalanx the tendon furthur divides into two slips to allow the flexor digitorum longus to pass through and gets inserted into sides of middle phalanx. The neurovascular supply to the

muscle arises proximally from the lateral plantar nerve and vessels as they pass laterally deep to the muscle.

Technique:

The muscle is exposed by a midline incision on the plantar aspect of the foot. The plantar aponeurosis is incised and reflected medially and laterally, and the muscle is identified deep to the fascia. The musculotendinous junctions are severed, and the muscle is turned back on itself proximally. Mobilization proceeds until the muscle covers the calcaneus, taking care not to injure the underlying lateral plantar nerve and vessels.

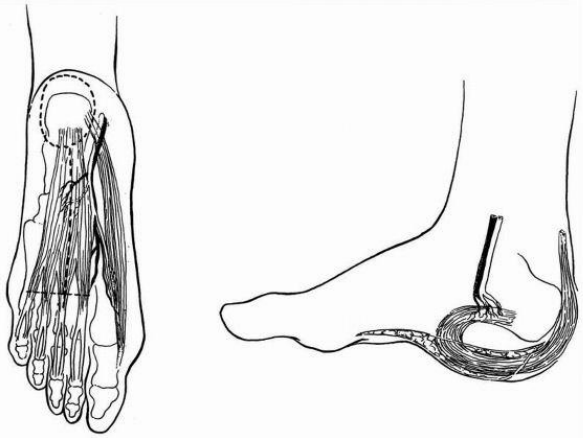


Fig.8 Flexor digitorum brevis muscle flap

c. Abductor digiti minimi:

Can be used to cover heel, lateral aspect of ankle.

The muscle arise from both the tubercle of calcaneum. The wide belly of the muscle narrows to a tendon over base of 5^{th} metatarsal and gets inserted over lateral aspect of proximal phalanx of 5^{th} toe.The neurovascular supply from the lateral plantar nerve and vessels enters the muscle near its origin.

Technique:

This muscle is exposed by an incision just above the lateral border of the foot that runs from the heel to the head of the fifth metatarsal. The tendon is divided near its insertion, and the muscle is dissected proximally where it requires separation from the flexor digiti minimi brevis. The lateral plantar vessels and nerves lie well to the medial border of the muscle between it and the flexor digitorum brevis

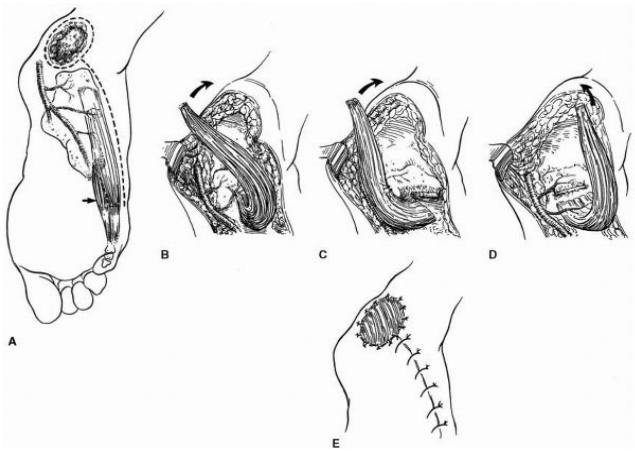


Fig.9 Abductor digiti minimi flap

4. **Microvascualar free flaps:**

Indications:

1. Large hind foot wounds (>6 cm)
2. Defects in patients devoid of the posterior tibial vessels from either trauma or disease
3. Patients who have been revascularized to the distal anterior tibial/dorsalispedis artery via bypass grafts

There is still debate on the choice of muscle plus skin graft versus fasciocutaneous flaps on the plantar surface of the foot holds up better under the stress of ambulation. Muscle flap and a skin graft are currently favored on the plantar aspect of the foot[14, 15].

Advantages of muscle with SSG:

1. Muscle flaps provide a better blood supply to the recipient site, making them the better choice for previously infected wounds[16].
2. Less wobbling compared to skin flaps

Advantage of fasciocutaneous flap:

1. Providing skin coverage while preserving underlying tendon motion
2. Fasciocutaneous flaps can be innervated, so that they could potentially be more effective on the sole of the foot in nonneuropathic patients.

Options:

1. Medial plantar artery free flap from the opposite leg seems to be the best available option
2. Rectus abdomins muscle flap[17]is very useful because it is a thin broad muscle, easy to harvest, has long pedicle and the donor site morbidity is minimal.
3. Gracilis[18]musclepedicle is somewhat smaller and shorter than that of the rectus abdominus muscle. Very useful for heel wounds where the anastomosis can be performed to nearby post tibial vessels.
4. Serratus anterior muscle flap[19.] - Using the two or threebottom slips of the serratus anterior muscle provides an adequate amount of soft tissue with a pedicle as long as 18 cm.
5. Lattismusdorsi –Harvesting this muscle in patients, who depend on crutches, can lead to severe functional disability. Hence, caution should be excised.

Disadvantages of free flap in sole reconstruction:

1. Tends to swell postoperatively which makes it more difficult to fit the foot into a shoe.
2. Flap wobbling will be a problem
3. Steep learning curve to perform the procedure

Additional maneuvers:

1. To reduce the flap swelling
    a. outflow should be optimized by performing two vein anastomoses
    b. The flap should be inset under tension so that it lies flat and at the same height as that of the surrounding tissue
    c. Compression therapy helps in improving the overall contour. Stockings with at least 30 mmHg should be worn by the patient
    d. Flap thinning can be done as a final resort.
2. Neurorrhaphy can be done to improve the reinnervation.

May and colleagues[17] reviewed their experience with patients who underwent free muscle transplantation and SSG to the weight-bearing portions of the foot and concluded that cutaneous sensibility did not appear to be necessary to maintain a functional and well-healed extremity.

5. Cross limb flaps:

These procedure require mentioning even though these procedures are superseded by microvascular free tissue transfer. These flaps might be useful when the microvascular facilities are not available or not possible. Though, its use should be limited to young individuals because of the need for immobilization in peculiar flexed positions. Current immobilization techniques make use of external fixators rather than plaster immobilization, which are more comfortable for the patient.

The available techniques are

1. Cross foot skin flap
2. Cross leg flap
3. Cross thigh flap

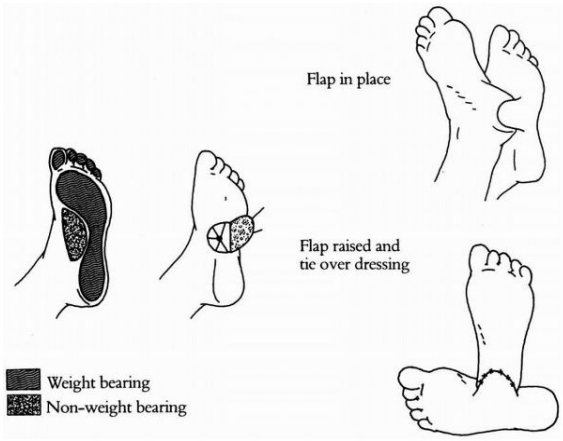


Fig.10 Cross foot Flap

2.Plantar Midfoot:

The part of foot between proximal tarsal row and midshaft of metatarsal bone is the midfoot.

1. V – Y advancement

Defects up to size 3 cm, this technique can be used. Single v-y advancement produces 1.5cm movement, so a double v-y advancement can cover a 3cm defect.

2. Neurovascular island flap

Neurovascular island flap from the fibular side of great toe can be harvested to cover defects of size 2-3 cm in forefoot and in midfoot[20-22]. For the mid foot defects the flap has to be raised till the metatarsak artery. Depending on the size of the flap the donor defect can be closed primarily or with a skin graft.[18, 19]

3. Medial plantar artery flap

4. Reverse sural artery flap

3.Plantar Forefoot:

The part of foot distal to mid shaft of metatarsal bone is the forefoot.

1**. Neurovascular island flap**

Neurovascular island flap from the fibular side of great toe can be harvested to cover defects of size 2-3 cm in forefoot and in midfoot[20-22]. Depending on the size of the flap the donor defect can be closed primarily or with a skin graft.[18, 19]

2. Toe Fillet Flap

Ideal for trophic ulcers over the head of the metatarsals. The main disadvantage is that one of the toe is sacrificed so that the skin of the sacrificed toe is used to cover the defect.

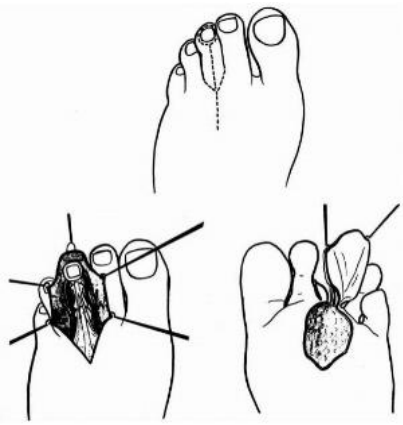


Fig.11 Filleted toe flap

3. V – Y advancement flap

Forefoot skin fat and fascia may be advanced in a V-Y fashion, to close wounds up to 3 cm. Single v-y advancement produces 1.5cm movement, so a double v-y advancement can cover a 3cm defect.

Post-operative care:

Immobilization and leg elevation are the two important concerns in the immediate post-operative period to optimize the outcome. The operated leg must be immobilized with pop slab for 2 weeks. Leg elevation is mandatory to reduce the edema. Weight bearing can be allowed gradually after one month. In patients with associated fractures weight bearing should be delayed till bone union is achieved as evaluated with serial radiographs or bone scan. Contour and stability of the foot reconstruction should be observed and monitored at 2 weeks post-operatively and 1, 3, 6 and 12 months.

Off-loading:

Off-Loading is a technique where an attempt is made to relieve or remove pressure from an area of weight bearing. It is required, when there is a wound or a bony prominence that causes increased pressure. It is particularly useful in sole reconstruction where most of the distant flaps used for

reconstruction are insensate and hence the chances of trophic ulceration, dehiscence at the junction of flap and the native sole is very high. These offloading devices can be in the form of custom made shoes, specialized foot wear or splints.Further these offloading devices are useful in patients who have undergone split skin graft in weight bearing areas of sole.

Complications:

Since most of the reconstruction techniques used in sole reconstruction are insensate complications rates are higher. Some of the complications are,

1. Trophic ulceration
2. Junctional dehiscence
3. Wobbling of flap

MATERIALS AND METHODS

This study was conducted at the Department of plastic and reconstructive surgery in Government Rajaji Hospital, Madurai on patients who are referred for reconstruction of sole defects during the period from December 2011 to December 2013. Over this period of two years, 60 consecutive patients underwent reconstruction for various type of defects in various regions of sole. All the patients who are referred to our department for sole reconstruction are included in this study, and those who had undergone previous surgeries on the sole, patients with active infection and patients with ischemic limbs are excluded from this study.

Defects are classified anatomically into Hind foot, mid foot and fore foot regions based on its location. The types of reconstruction i.e. skin graft, local flap, distant flap and free flap are planned based on the clinical judgment, patient's requirement and the availability of local tissues. All the patients are operated under appropriate anesthesia with tourniquet. Post operatively leg end of the patient is elevated and immobilized with a below knee pop slab for two weeks. Flaps are monitored periodically in the immediate post-operative period. For Skin grafts, first dressing is changed on the 3rd post-operative day and is followed on 5th day liquid paraffin dressings.

Patients are advised regarding the foot care and daily self-examination of the foot. They are given with compression and appropriate offloading devices. Compression is given with a 6 inch crepe bandage. Appropriate offloading to the operated site is given with customized sandals and splints when the patients start to bear weight around 4 weeks post operatively. Offloading and compression are advised for a period of six months.

All the patients are followed-up for a period of one year. Patient are evaluated for flap condition, complications, durability of the reconstruction, return of sensation and patient satisfaction at one, six and twelve month post-operative period. The details are collected in a proforma and the results are analyzed.

Type of Study: Prospective study

Period of study: Two years (Dec 2011 – Dec 2013)

Place of study:

Department of plastic & reconstructive surgery, Government Rajaji Hospital, Madurai.

Inclusion Criteria:

All the cases referred for reconstruction of sole defects to plastic surgery department.

Exclusion Criteria:

1. Patients who had undergone previous surgeries in the sole
2. Defects with active clinical signs of infection
3. Defects in ischemic limbs

RESULTS& ANALYSIS

Table 1: Age wise Distribution

Age	Count
0-10	5
11-20	7
21-30	11
31-40	13
41-50	9
51-60	7
>60	8
Mean age Range	37.21 8 – 65

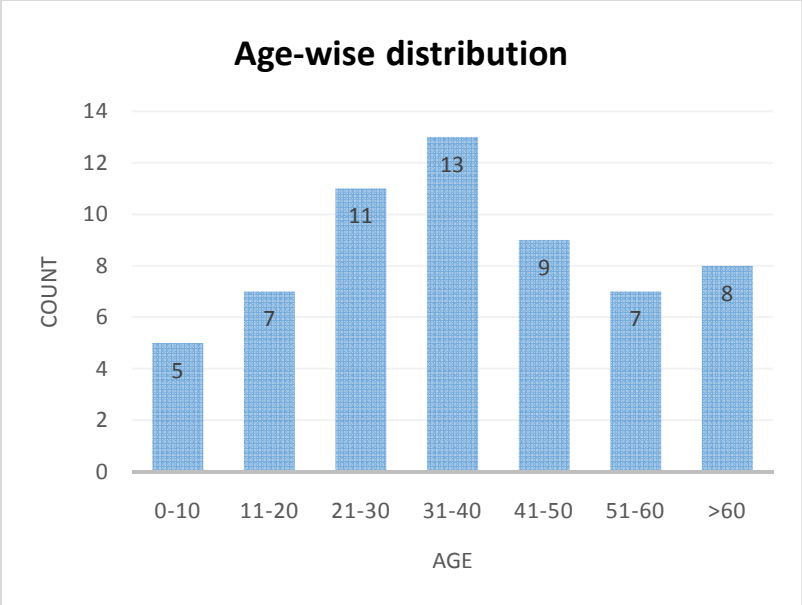


Table 2: Sex Distribution

Sex	Number
Female	16
Male	44

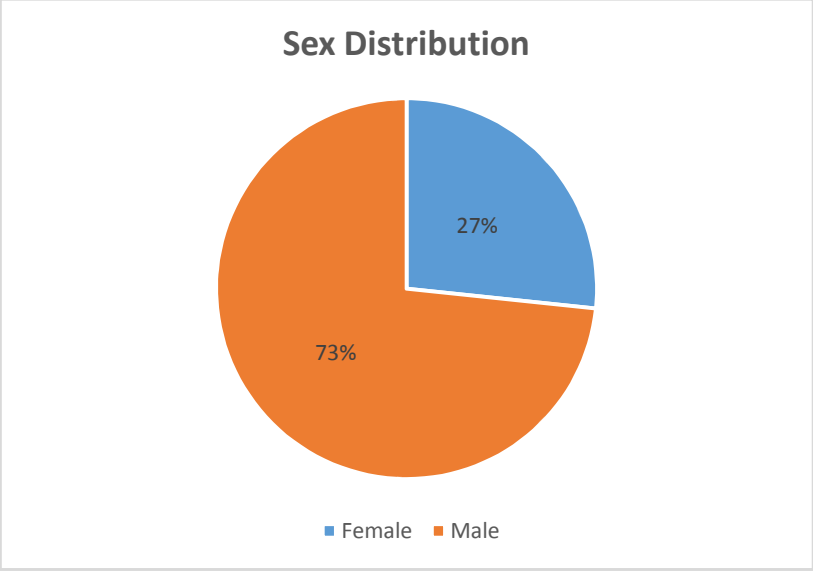


Table 3: Leg involvement

Leg involvement	counts
Both	1
Left	25
Right	34

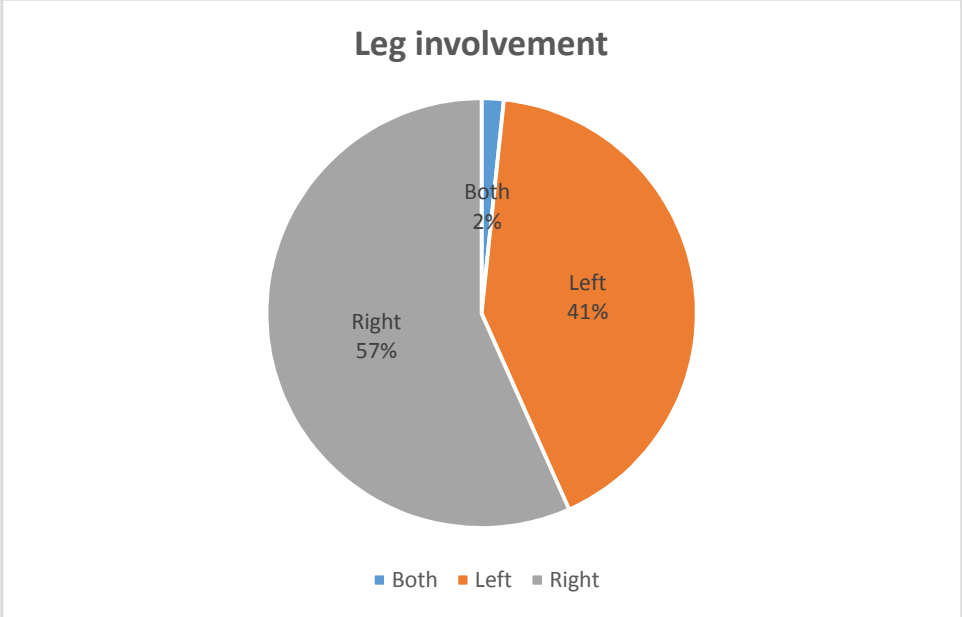


Table 4: Anatomical Location of defects

Location	Counts
Hind	37
Mid	11
Forefoot	6
Combined	6

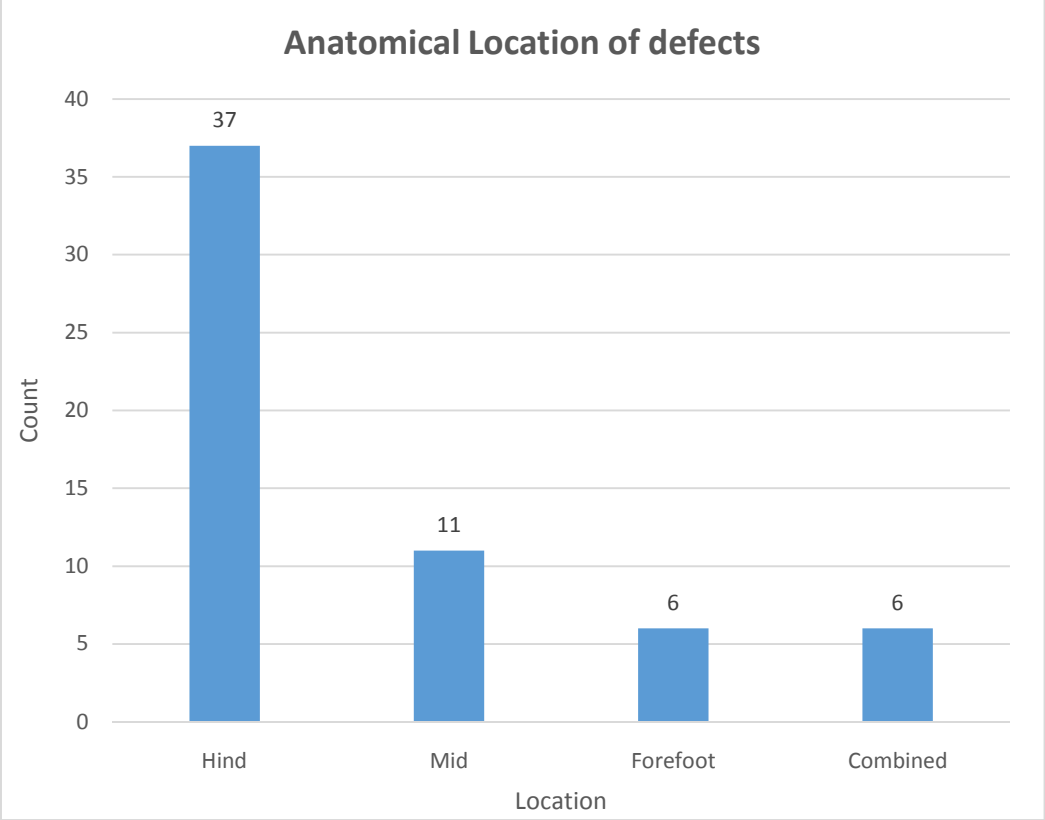
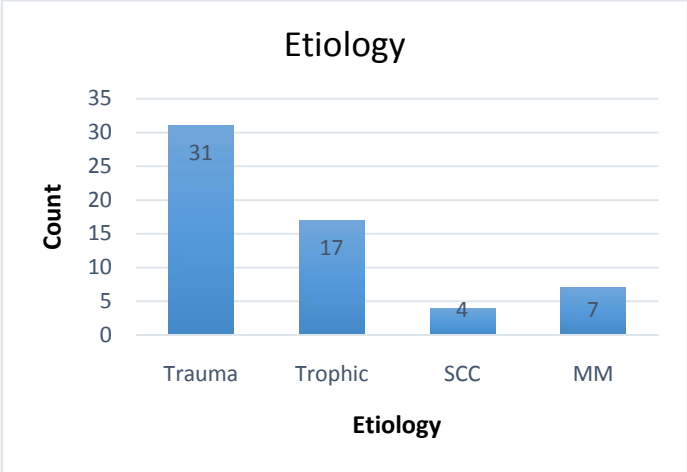


Table 5: Etiology

Etiology	Counts
Trauma	31
Trophic a. Diabeticperipheral neuropathy b. Meningomyelocele c. Hansen's disease d. Idiopathicperipheral neuropathy	 12 3 1 1
Squamous cell carcinoma	4
Malignant melanoma	7



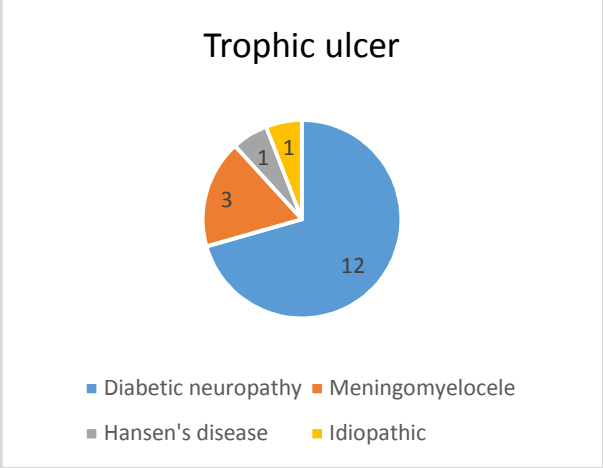


Table 6: Treatment Techniques

Procedure	Counts
SSG	21
Flap	34
Ray Amputation	5

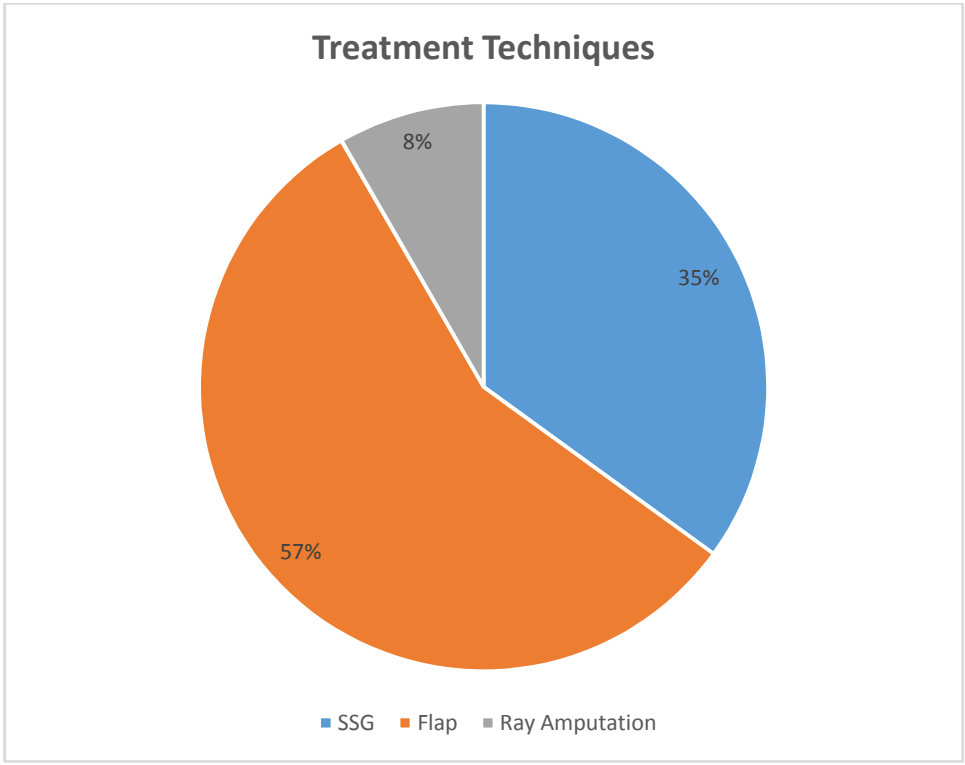
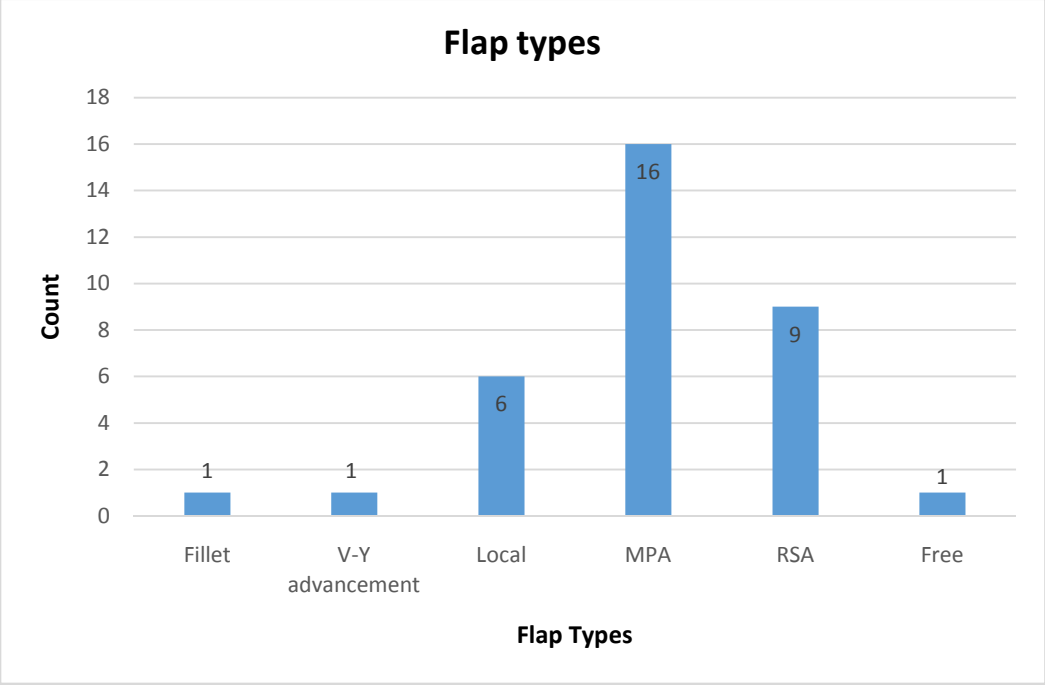


Table 7: Flap types

Flap type	Counts
Fillet	1
V-Y advancement	1
Local	6
MPA	16
RSA	9
Free	1



DISCUSSION

Large sector of the patients fall under to 21-40 age group. That is (n=24) 40% of cases belong to this group. Trauma is the most common etiology in this group. These are the active working population. Defects in these patients will incapacitate them. So they need to return to their work environment as early as possible. Malignancy is the common etiology in people above 60 years age group. In pediatric age group, the common etiology seems to be trophic ulceration due to foot deformity resulting from previous meningomyelocele.

73% of cases (n=44) are male whereas 27% of cases (n=16) are female. The occurrence of accidents are more frequent these days. Since, men are mostly involved in road traffic accidents, the prevalence of the sole defects are common in male population.

Based on the anatomical distribution of the defects right leg (n=34) is most commonly involved in 57% of cases, whereas the left (n=25) is involved in 41% of cases in the study. In the foot commonly involved sub site is the hind foot followed by mid foot and fore foot. Hind foot is involved in (n=37) 61.6% of patients. Mid foot is involved in (n=11) 18.3% of patients. Fore foot is involved in (n=6) 10% of the cases. Further, defects involve more than one region.

Among the total 60 cases, trauma is the most common etiology in this study. It occupies around 51.6% (n=31) of the study. Followed by trophic ulceration (n=17), which occupies 28.3% of the study. Amongst the trophic ulceration group the underlying causes are due to diabetic peripheral neuropathy, meningomyelocele and Hansen'ssequlae. Of these, the predominant is diabetes mellitus which occurred in 12 out of 17 cases (70.5%). Meningomyelocele is in 3 cases (17.64%). In one case, it is due to Hansen's disease sequlae and in the other, the cause is not known. Malignancy occurred in 11 out of 60 cases which accounts for 18.3% of cases. The incidence of malignancy is high because Government Rajaji Hospital is a tertiary care center where complicated cases gets referred to. Of malignancy, malignant melanoma is the most common (n=7) and has occurred in 11.6% of the cases and squamous cell carcinoma accounts for 6% (n=4) of cases. All the cases of squamous cell carcinoma is found in patients above 60 years of age, whereas malignant melanoma has occurred after 40 years.

Of 60 patients, reconstruction was done with flaps in 57% (n=34) cases and split skin graft in 35% (n=21) cases. 8% (n=5) of cases has undergone ray amputation.

1. Medial plantar artery flap:

Medial Plantar artery flap was used in 47% (n=16) of cases. Medial plantar artery flap was used for defects in hind foot (n=14) and midfoot (n=2). Of the 16 cases 6 lost long term follow up. These cases were followed up at 1, 6 and at 12 months post-operative period. They were evaluated for complications, flap condition, durability, sensibility and patient satisfaction.

The complications encountered in medial plantar artery flap was in the immediate post-operative period was partial graft loss and dehiscence in suture line. Graft loss occurred in 3 out of 16 cases (18.75%) at the margins. All these cases didn't require regrafting as the graft loss was only partial, amounting for 10% of grafted area. They were managed conservatively. The graft loss can be minimized by beveling the edge of the flap while raising it. When beveling of the edge is not done, it produces a punched out edge and fixing the graft at the edge becomes difficult and there exists a chance for graft loss. The other complication was dehiscence, which occurred in one patient. This occurred, as the patient didn't comply with the strict immobilization protocol. This was managed with secondary suturing.

The flap condition and durability was excellent in all of the long term follow up. There was no recurrence of trophic ulcer and break down of flap in

12 months follow-up. The flap donor area posed no complications in long term follow-up. The grafted area contracts secondarily and reduces to about half of the original flap size. Breakdown of SSG site or ulceration in the grafted area was not encountered in 12 month follow up.

As the medial plantar artery flap is a sensate flap, patient with sensible sole had the two point discrimination identical to that of native sole skin in long term follow-up. 3 of 16 patients where the flap was used had insensate sole; Long term follow-up of these case didn't have any recurrent trophic ulcers. Even in patient with insensate sole this flap gives good durable cover as the native sole skin is used.

Patient satisfaction was extremely good with medial plantar artery flap. 10 out of the 10 patients (100%) rated extremely satisfied with this reconstruction. The flap is not bulky and it didn't hinder the patient from wearing shoes or other foot wears.

Medial plantar artery flap provides multiple advantages like,

1. Single stage procedure
2. Native sole skin is used – Replacement of same kind of tissue
3. Sensate flap – prevent recurrence
4. Donor site morbidity is very less

4 of 16 cases were not islanded. The flap was raised as a pedicled flap. Though a dog-ear appear prominent in the immediate post-operative period. It settles down with compression bandages in six months' time. Raising it to be a pedicled flap reduces the operative time and blood loss intraopertively.

2. Reverse sural artery flap:

Reverse sural artery flap was done in 26.4% (n=9) cases. This flap was used in defects of hind foot in 6 cases and 2 cases where the defect was extending onto the mid foot and 1 case in mid foot region. All the cases were followed up for complication, flap condition, durability and sensibility and patient satisfaction in the immediate post-operative period, after one month, six and twelve months period. Of the nine cases one case lost follow up.

Complications encountered:

1. Marginal necrosis – 1 case. Where the extended flap was used for defect in both hind and mid foot region. About 1 cm of flap necrosed and there was suture line dehiscence. This case was managed with surgical debridement of the necrosed part and reattachment of the flap.
2. Graft loss – There was marginal loss of graft in two cases. This occurred as a result of donor site reduction with vicryl sutures in tension. Both the

cases were managed conservatively. This problem can be overcome by applying the graft over the donor area without reduction of donor area.

3. Trophic Ulceration – This occurred in 4 of 8 cases (50%). This was noticed on the sixth month follow-up. All the four patients were manual laborers. They have not used the offloading shoes given to them. These ulcers healed when appropriate offloading device was strictly followed.
4. Hair growth – Hair growth on the flap occurred in 4 of 4 male cases where the flap was used. This was seen till 3-4 month postoperative period. At six and twelve month follow-up the hair growth on the weight bearing region was almost nil as the flap skin thickened.

The flap durability was fair. Because there will be ulceration when offloading devices are not followed strictly. Also due to the phenomenon of wobbling of the flap ulceration at the junction of flap and native sole is common.

Sensation on the flap was assessed. 8 of the 8 cases had protective sensation of the flap when reviewed at six months. But none of the patient had the two point discrimination compared to the sole skin at twelve month review as it is not a sensate flap. Hence custom made shoes are mandatory to prevent damage to the flap.

When patient satisfaction was evaluated, 4 of the 8 (50%) patient were unsatisfied with the flap. 3 of the 8 patients (37.5%) rated - acceptable. 1 of the 8 cases rated - satisfied on long term follow up. The reasons for patient unsatisfaction are evaluated. The reasons stated are

1. Multi stage procedure – As the flap required 3 stages i.e. flap delay, flap elevation and inset and flap division; they needed hospitalization for each procedure, undergo anesthesia for the same and recurrent expense. Sometime they might require to undergo 4^{th} stage to debulk the flap. These many stages, patient felt it is an inconvenience for them.
2. Not able to wear shoes – 2 of the 4 patient who were unsatisfied with the flap stated that they were not able to wear their regular shoes due to the bulky nature of the flap.
3. Hair growth on the flap – 2 of the 4 patient stated this as one of the reasons. Since most of the south Indian population wear slippers, the hair growth is visible.
4. Problem of recurrent ulceration.

So due to multiple problems and patients dissatisfaction reverse sural artery flap should be done only in cases where there is no adequate local sole tissue and where the microvascular facility is not available.

3. Fillet flap :

Filleted toe flap was used in one of the cases. It was used in a case of trophic ulcer in the fore foot in the region of 3rd metatarsal head with associated osteomyelitis in a diabetic patient. Defect size was 3 x 3 cm. A filleted flap from 3rd toe was used to close the defect. It provided a good sensate cover to the sole. There was no complication encountered using the filleted flap. The durability was excellent and the flap sensation was identical to the native sole skin. Patient satisfaction was good with this flap. The only problem with this flap is convincing the patient about removing the toe.

4. Local Flaps:

Four types of local flaps were used in this study. 5 of 7 cases rotation flap was used to cover defects in the hind foot. Maximum size of the defect was 3cm where the rotation was used. In one of the case a transposition flap was used to cover defect in the mid foot region. The size of the defect was 3cm. One case of v-y advancement was done for defect in the forefoot region.

It was a trophic ulcer of size 2x2 cm were a single v-y advancement was used.Limberg flap for a 1cm trophic ulcer in great toe.

The complications encountered with rotation flap was dehiscence and recurrent trophic ulceration at the suture line. Dehiscence occurred in 1 of the 5 cases where rotation flap was used. Larger the size of the defect, more will be the tension in suture line and higher will the chance for dehiscence. So for defect more than 4cm rotation flap should not be used in sole defects.

Durability was excellent and the flap sensation is identical to that native sole skin. Patient satisfaction was good with these flaps.

5. Free flap:

One case of free gracilis muscle flap was done for total heel pad avulsion. The avulsed heel pad was not amenable to replantation as it was crushed and not salvageable. The problems encountered with the free muscle transfer is on the long term. That is small ulcerations on the pressure points that refuses to heel. Since the whole sole is covered with SSG, even with offloading devices these ulceration tend to occur on the pressure points. Durability is not good due to frequent breakdown of grafts. The reconstructed sole will not be sensate. In Patient satisfaction level the patient rated as acceptable owing to the nature of the defect.

6. Split skin graft:

Split skin graft was done in 35% of the cases (n=21). In 15 cases (71.4%) the defect was in mid foot on the non-weight bearing region. 3 cases the defect was in hind foot, 1 cases the defect was in the fore foot and 2 cases the defect was combined, both in mid and hind foot. 18 of the 21 cases (85.1%) the defect was due to trauma and 3 of the cases was due to malignancy. In cases were split skin graft was applied to pressure bearing areas; 4 of 21 (19%) the wound was left to granulate till it is level with the native sole, so that contour irregularities can be avoided. 6 of the 31 cases lost follow up, other 15 cases were followed on 1, 6 and 12^{th} month postoperatively.

The problems encountered were mostly in cases where skin graft was applied to pressure bearing areas. There was break down of graft and ulceration in the pressure bearing areas. Most of the patients don't use the offloading device prescribed. They find the offloading device as a hindrance and hence the compliance is poor. All the ulceration were managed conservatively. But the healing period is prolonged and requires absolute immobilization and offloading.

The durability of the graft is not good. There is no sensation in the grafted sole. But some protective sensation returned in 5 of the 15 cases. On

evaluation for patient satisfaction 6 of the 15 patients (40%) rated unsatisfactory for Split skin graft. The reasons stated were due to recurrent ulceration, poor colour match and due to contour irregularities. Patient who underwent skin graft in non-weight bearing areas rated satisfactory.

7. Ray Amputation:

Ray amputation of the toe was done in 8.3% of cases (n=5). In all cases it was due to malignancy in the forefoot region. In two cases the 5^{th} toe was removed and in 3 cases 4^{th} and 5^{th} toe were amputated. 4 of the 5 patients lost follow-up. There was no complications in the patient followed up at 1, 6 and 12 months postoperatively. Patient satisfaction was fair as the deformity caused by the amputation is a concern for the patient.

Case 1: Medial plantar Artery Flap

A.Trophic Ulcer in mid foot region. MPA flap markings

B. Defect recreation, Flap incisons

C. MPA flap, immediate post-operative period

D. 1 month post-operative period. Marginal graft loss

E. 12 month post-operative follow-up

Case 2: Abductor hallucis to fill cavity in a Trophic ulcer

A. Trophic ulcer in hind foot

B.Abductor hallucis used to fill cavity

C. MPA flap with SSG

Case 3: Rotation Flap

A. Trophic ulcer – Hind Foot

B. Rotation Flap

C.6 months Follow-up

D.12 month Follow-up

Case 4: Filleted Toe Flap

A.Trophic ulcer – Fore foot

B. Debridement

C. Flap Design

D. Flap inset

E .Dorsal view

Case 5: Limberg Flap

A.Trophic Ulcer over great toe

B.Limberg flap

Case 6: Split skin graft

A. Split skin graft – Non weight bearing area – Hind foot

B. Split Skin graft to weight bearing area – Hind and Mid foot

Case 7: Ray Amputation

A. Malignant Melanoma – Fore foot

B. Ray amputation of 5th Toe

C. Ray amputation – Dorsal view

Case 8: Free Gracilis Flap

A. Total Heel pad avulsion

B. Free Gracilis muscle transfer

C. Immediate Post-operative period

Case 9: Reverse sural Artery Flap

A. Post traumatic heel pad avulsion

B. Mid and Hind foot defect

C. Extended RSA Flap markings

D.1 months Follow-up, before flap division – Hair growth and trophic ulceration

E. 12 month follow up – trophic ulceration, no hair in the weight bearing region

Case 10: Reverse sural artery flap for mid foot

A. Deformed foot – Trophic ulceration in mid foot in a case of meningomyelocele

B.6 months follow-up

Offloading Device

A.Offloading Device – for the mid foot

B.Patient wearing the offloading device

Complications

A. Reverse sural artery flap

i. Recurrent trophic ulceration
ii. Hair growth
iii. Poor colour match

iv. Junctional ulcer

SSG to weight bearing region

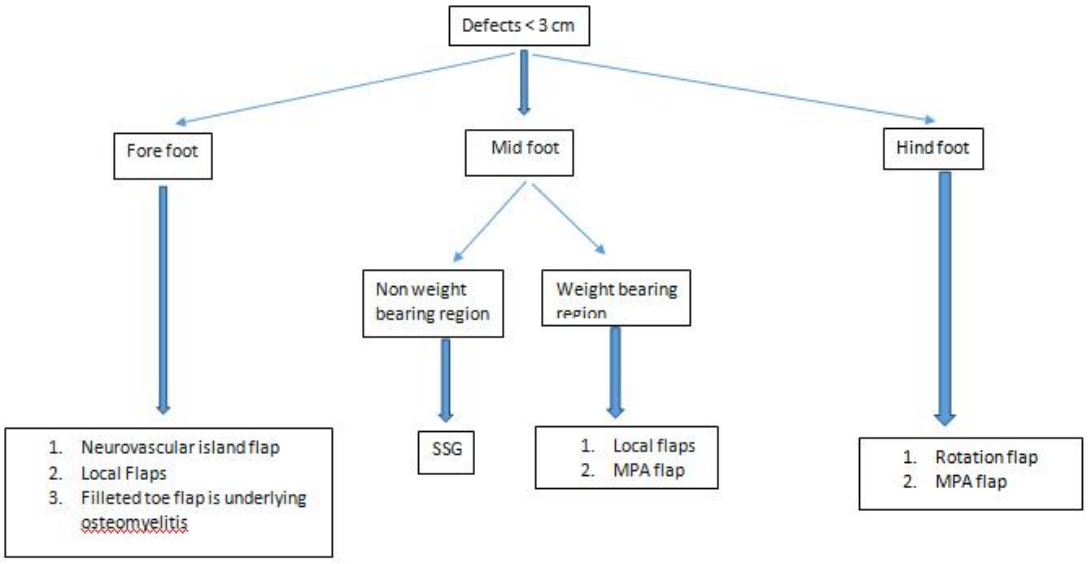
A. Trophic ulceration without the use of offloading

CONCLUSION

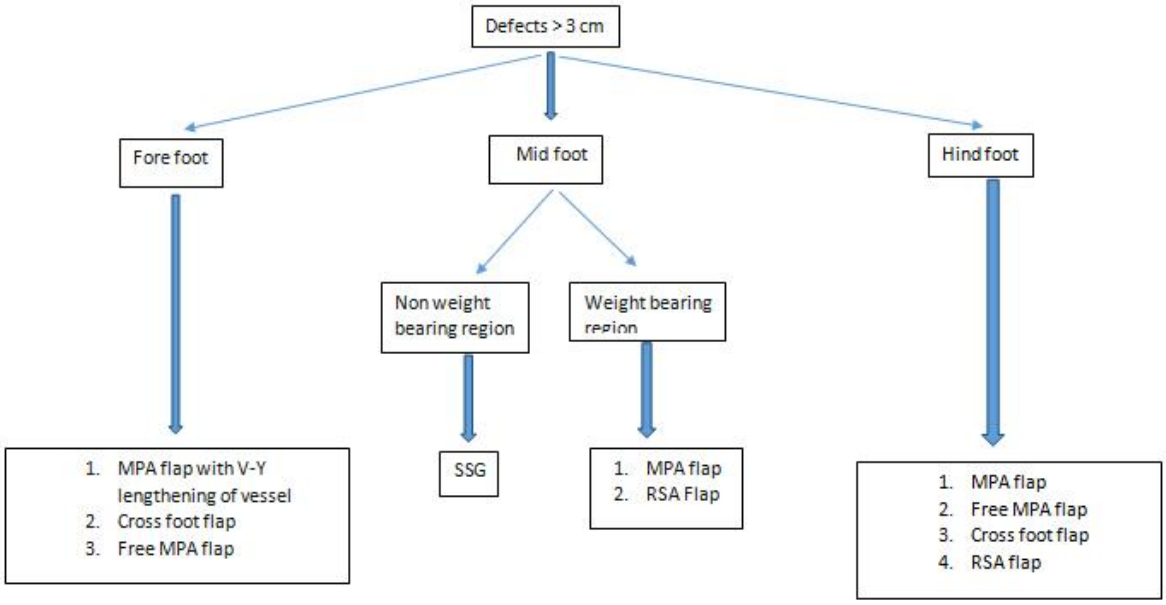
- Medial plantar artery flap is the flap of choice for sole defects in mid and hind foot region resulting from any cause. It provides multiple advantages as follows,
    1. Replacement of sole skin by sole skin.
    2. Sensate flap
    3. Single stage procedure
    4. Good patient satisfaction
    5. Donor site morbidity is negligible.
- For small defects the next best flaps are the local flaps from the nearby tissue. These local flaps can be used only for defects less than 3 cm. Rotation are best suited for heel defects, transposition flap from mid foot defects, and v-y advancement for forefoot defects. Care should be taken while using these local flaps. The skin graft, if used for donor site closure, should be on the non-weight bearing area. Similarly the suture line should be on the non-weight bearing area.
- Filleted toe flap and neurovascular island flaps are ideal flaps for defects in fore foot as it provides sensate skin to the pressure points.

- Non weight bearing areas of the sole can skin grafted if adequate granulation tissue is present to prevent contour deformities.If it is used for weight bearing areas strict offloading should be followed.
- Reverse sural artery flap should be done as last resort when all the local flaps and in places where microvascular facilities are not available as it has multiple disadvantages.
- Microvascular free flaps should be done for extensive defects where no local flaps from native sole is present.
- Cross foot flap is an ideal option available for large sole defects, but less used these days as immobilization is required. Alternatively, microvascular free instep flap from the other leg can be done without the need for immobilization in peculiar position.
- Muscle flaps can be used to fill cavities in trophic ulcers.
- Whatever the type of reconstruction is used, unless appropriate offloading is not done recurrent ulcerations tend to occur.
- Foot wear inspection and foot self-examination is mandatory for these patientto prevent recurrent ulceration.

Algorithmic approach to sole defect



Algorithmic approach to sole defectcont....



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PROFORMA

Name : Age: Sex: IP number:

Address:

Contact Number:

History:

Clinical Examination:

Diagnosis :

Plan:

Procedure done:

Follow up

	Immediate postop	1 month	6 month	1 year
Flap condition				
Complication				
Durability				
Sensation				
Patient satisfaction				

Ref. No. 23483 /E4/3/2013

Govt. Rajaji Hospital,
Madurai.20. Dated: . 02.2013

Institutional Review Board / Independent Ethics Committee.
Dr. N. Mohan, M.S., F.I.C.S., F.A.I.S.,
Dean, Madurai Medical College & 2521021
Govt Rajaji Hospital, Madurai 625020.
Convenor

Sub: Establishment-Govt. Rajaji Hospital, Madurai-20-
Ethics committee-Meeting Agenda- approval -regarding.

The Ethics Committee meeting of the Govt. Rajaji Hospital, Madurai was held at 11.00 Am to 1.00 Pm on 28.01.2013 at the Surgery Seminar Hall, Govt. Rajaji Hospital, Madurai. The following members of the committee have attended the meeting.

1.Dr. V. Nagarajan, M.D., D.M (Neuro) Ph: 0452-2629629 Cell.No 9843052029	Professor of Neurology (Retired) D.No.72, Vakkil New Street, Simmakkal, Madurai -1	Chairman
2. Dr.Mohan Prasad , M.S M.Ch Cell.No.9843050822 (Oncology)	Professor & H.O.D of Surgical Oncology(Retired) D.No.72, West Avani Moola Street, Madurai -1	Member Secretary
3. Dr.L. Santhana Lakshmi,MD Cell.No 9842593412	Associate Professor of Physiology/V.P Madurai Medical College	Member
4. Dr. Parameswari M.D (Pharmacology) Cell.No.9994026056	Director of Pharmacology Madurai Medical College	Member
5. Dr.Moses K.Daniel MD(Gen.Medicine) Cell.No 09842156066	Professor & H.O.D of Medicine Madurai Medical College	Member
6. Dr.D. Soundara Rajan,MS(Gen.Surgery) Cell.No 9842120127	Professor & H.O.D of Surgery Madurai Medical College	Member
7. Dr.Angayarkanni MD(O&G) Cell.No 9443567724	Professor & H.O.D of O&G Madurai Medical College	Member
8. Dr.P.V. Pugalenthi M.S, (Ortho) Cell.No 9443725840	Professor & H.O.D Ortho Madurai Medical College	Member
9. Dr. M. Sundarajan M.S., Mch Cell.No 9994924369 (Neuro Surgery)	Professor (Neuro Surgery) Madurai Medical College	Member
10 Thiru..Pala. .Ramasamy , BA.,B.L., Cell.No 9842165127	Advocate. D.No.72.Palam Station Road, Sellur, Madurai -2	Member
11. Thiru. P.K.M. Chelliah ,B.A Cell.No 9894349599	Businessman, 21 Jawahar Street, Gandhi Nagar, Madurai-20.	Member

The following Project was approved by the committee.

Dept of. Plastic Surgery

Name of P.G.	Course	Name of the Project	Remarks
Dr.G.Arun	PG in M.Ch (Plastic Surgery), Madurai Medical College, Madurai.	" A predictable comparison of ideal skin cover for sole defects of various Etiology"	Approved

Please note that the investigator should adhere the following: She/He should get a detailed informed consent from the patients/participants and maintain Confidentially.

1. She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the institution to Government.
2. She/He should inform the institution Ethical Committee in case of any change of study procedure site and investigation or guide.
3. She/He should not deviate for the area of the work for which applied for Ethical clearance.

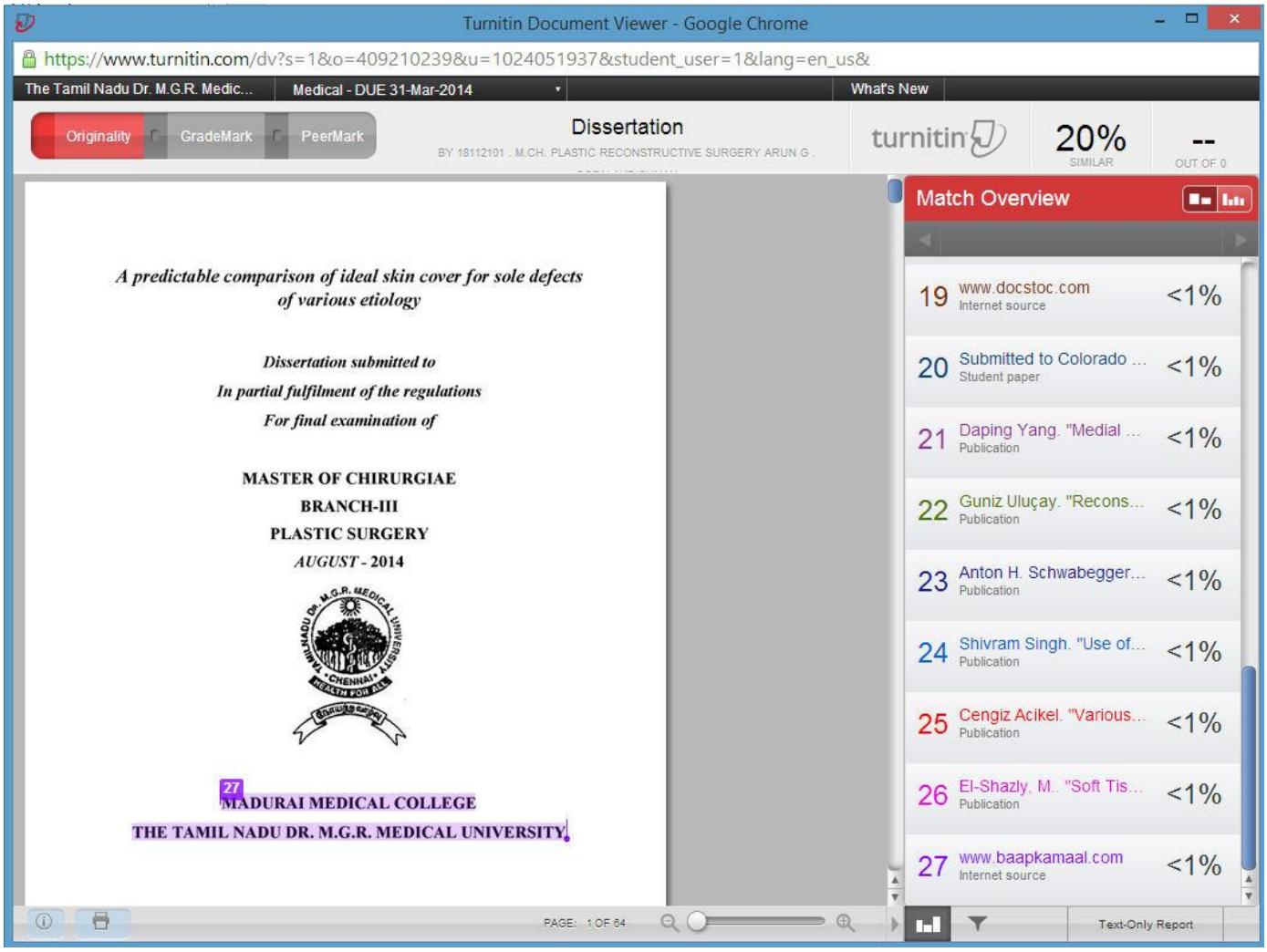
She/He should inform the IEC immediately, in case of any adverse events pr Serious adverse reactions.

4. She/he should abide to the rules and regulations of the institution.
5. She/He should complete the work within the specific period and apply for if any Extension of time is required She should apply for permission again and do the work.
6. She/He should submit the summary of the work to the Ethical Committee on Completion of the work.
7. She/He should not claim any funds from the institution while doing the word or on completion.
8. She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Member Secretary **Chairman**

DEAN/Convenor,
Govt. Rajaji Hospital,
Madurai-20.
1/2/13

To
The Principal Investigator-thro' Head of the Departments concerned.
31/1/13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In partial fulfilment of the regulations
For final examination of
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BRANCH-III
PLASTIC SURGERY
AUGUST - 2014
MADURAI MEDICAL COLLEGE
THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY
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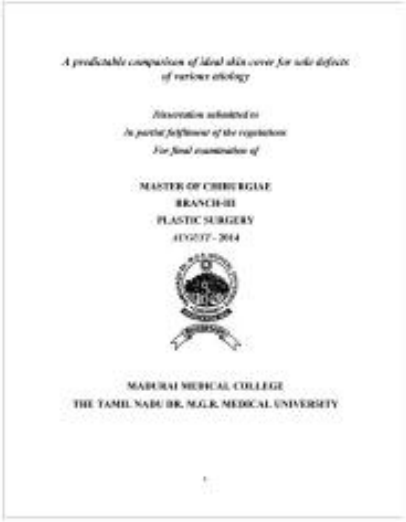

A predictable comparison of ideal skin cover for sole defects of various etiology

Dissertation submitted to
In partial fulfilment of the regulations
For final examination of

MASTER OF CHIRURGIAE
BRANCH-III
PLASTIC SURGERY
AUGUST - 2014

MADURAI MEDICAL COLLEGE
THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY

MASTER CHART							
S.No	Age	Sex	IP no	Side	Location	Etiology	Reconstruction
1	32	M	37475	R	Hind	Trauma	ssg
2	33	M	44681	R	Mid	Trauma	ssg
3	8	M	55698	L	Hind	Trophic, Meningomyelocele	ssg
4	23	F	57689	L	Mid	Trauma	ssg
5	40	F	75489	L	Hind	Trauma	RSA
6	24	M	79871	L	Hind	Trophic	MPA
7	50	M	87099	L	Hind	Trauma	RSA
8	24	M	79871	R	Hind	Trauma	ssg
9	9	F	67091	R	Hind	Trophic	MPA
10	31	M	74792	L	Hind,Mid	Trauma	ssg
11	58	M	12698	R	Hind	Trauma	MPA
12	65	M	10817	R	Hind	Trophic	MPA
13	17	M	32131	L	Mid	Trauma	Transposition
14	22	M	32415	L	Mid	Trauma	ssg
15	28	M	35874	L	Hind	Trauma	RSA
16	45	F	43355	R	Hind	MM	MPA
17	40	M	41603	R	Hind	Trauma	SSG
18	10	M	42564	L	Hind	Trophic	Rotation
19	43	F	52621	L	Forefoot	Trauma	ray amputation
20	34	F	54212	R	Hind	trophic	Rotation
21	17	M	51422	L	Hind	Trophic	Rotation
22	26	F	61234	L	Hind	TROPHIC	MPA
23	20	F	79422	R	Mid	Trophic	RSA
24	18	F	99175	R	Forefoot	Trophic	V-Y advancement
25	9	M	94758	L	Hind,Mid	Trophic	RSA
26	63	M	98745	L	Frfot	Diabetic	ray amputation

S.No	Age	Sex	IP no	Side	Location	Etiology	Reconstruction
27	10	M	4060	L	Hind	Trophic	SSG
28	30	F	4125	R	Hind	Trophic	MPA
29	33	M	30035	R	Hind	Trauma	RSA
30	34	F	43132	R	Hind	Trophic	Rotation Flap
31	41	M	39936	Both	Hind,Mid	Trauma	SSG
32	55	M	30864	R	Hind	MM	MPA
33	45	M	39998	R	Hind	Trauma	ssg
34	65	M	55911	R	Hind	MM	MPA
35	20	M	56985	L	Forefoot	Trauma	ray amputation
36	48	M	65400	L	Hind	Trophic	MPA
37	55	M	68793	L	Hind	Trauma	ssg
38	30	F	45869	R	Mid	Trauma	ssg
39	62	M	58694	L	Hind	SCC	RSA
40	50	F	45684	R	Mid	Trauma	ssg
41	23	M	65458	R	Hind,mid	Trauma	ssg
42	63	M	85695	L	Hind	SCC	RSA
43	19	M	78958	R	Hind	trophic	MPA
44	26	M	47584	R	MId	Trauma	ssg
45	20	M	45632	R	Hind,mid	Trauma	ssg
46	61	M	44758	R	Hind	Scc	RSA
47	55	M	45422	L	Mid	Trauma	ssg
48	65	M	69854	R	Forefoot	SCC	ray amputation
49	60	M	78522	L	Hin	Trauma	ssg
50	45	M	14525	R	Mid	Trauma	ssg
51	34	M	4521	R	Mid	Trauma	ssg
52	56	M	5696	R	Hind	Trauma	ssg
53	65	F	4587	R	Forefoot	MM	ray amputation

S.No	Age	Sex	IP no	Side	Location	Etiology	Reconstruction
54	50	M	2587	L	HIND	MM	MPA
55	35	M	55566	R	Forefoot	Trophic	Fillet
56	56	F	85963	R	Hind	MM	MPA
57	26	M	85966	R	Hind,Mid,forefoot	Trauma	Free
58	33	M	85246	R	Hind	Trauma	MPA
59	39	M	47854	L	Hind	MM	MPA
60	35	F	58745	R	Mid	Trauma	Rotation